

Summary of Evaluation Results

I. Outline of the Project	
Country: Plurinational State of Bolivia	Project Title: Study on Impact of Glacier Retreat on Water Resource Availability for cities of La Paz and El Alto
Issue/Sector: Water Resources / Disaster Management-Comprehensive Water Resources Management	Cooperation Scheme: Technical Cooperation Project
Division in Charge: Water Resource Management Division 2, Global Environment Department	Total cost: 270 million yen at the time of the Terminal Evaluation
Period of Cooperation	Record of Discussion (R/D): 19 January 2010
	April 2010 - March 2015 (five years)
	Partner Country's Implementing Organization: Major University of San Andrés (UMSA) Ministry of Environment and Water (MMAyA) Japan's Implementing Organization: Tohoku University, Tokyo Institute of Technology, Fukushima University and Nihon University Related Cooperation: IRD (France): "Le Service d'observation GLACIOCLIM - Andes" WB: "Andes Adaptation to the Impact of Climate Change in Water Resources" (PRAA)
<p>I-1 Background of the Project</p> <p>Bolivia, situated in the Tropical Andes with an average annual precipitation of about 500mm, largely depends on melt water from glaciers for its water resources. It is predicted, however, that these glaciers in the Tropical Andes will disappear in the next 30 to 40 years due to the effects of climate change; and Bolivia is faced with a potential depletion of water resources. Regarding the quality of water resources, the decrease of current flow of rivers due to glacier retreat is estimated to cause the increased pollution load in rivers and lakes, in addition to more and more intensively increasing demand. Furthermore, it is predicted that soil erosion at times of heavy rainfall will bring about sediment and reduce the water storing capacity of reservoirs, which would worsen the shortage of available water resource amount of the country.</p> <p>Considering these circumstances, Bolivia is compelled to take appropriate measures for its water resource management based on scientific information on the supply and demand of water. The country, however, has inadequate number of experts on water problems, and is lacking observation networks of water quality and collected data management, as well as the development of scientific models to evaluate the water resource availability, particularly in the context of climate change impact.</p> <p>It is of urgent necessity for Bolivia to promote researches on the available amount of water resources taking into account the disappearance of glaciers, and to develop a modeling of water resource management for its possible application to adaptation policies. As such, this Project was formulated under the scheme of Science and Technology Research Partnership for Sustainable Development (SATREPS) and the Record of Discussion (R/D) was signed on 19 January 2010. The Project started with the dispatch of Japanese experts/researchers to Bolivia in April 2010.</p>	
<p>1-2 Project Overview</p> <p>(1) Overall Goal: The system of modeling, scientific insight and investigation results are applied to the formulation of policies of water supply under climate change scenarios.</p> <p>(2) Project Purpose: Support system is developed for the formulation of water resource management policies under climate change scenarios, in the cities of La Paz and El Alto.</p> <p>(3) Outputs</p> <p>Output 1: Glacier melting model under climate change scenarios is developed for glaciers of Tuni-Condoriri and Huayna Potosi West.</p>	

Output 2:	Water balance model is developed, which accompanies to hydrometeorological and land use changes for the cities of La Paz and El Alto.	
Output 3:	Model of erosion and sediment transport is developed under climate change scenarios in the basins of the glaciers of Tuni-Condoriri and Huayna Potosi West.	
Output 4:	Model of water quality for Tuni Reservoir is developed under climate change and land use change scenarios.	
Output 5:	Model for the evaluation of the impact on water resources is developed under climate change and land use change scenarios for the cities of La Paz and El Alto.	
Output 6:	Possible adaptation policies to climate change scenarios for water resources management are considered, applying the models developed by the results from 1 to 5 for the cities of La Paz and El Alto.	
(4) Inputs		
Japanese Side: approximately 270 million JPY (at the time of evaluation)		
Long-term Expert: 1 expert		
Equipment: 46,117,000 JPY		
Short-term Expert: 11 experts		
Number of Trainees Received: 12 participants in Trainings in Japan and 8 long-term trainees		
Local Cost: 2,070,000 bolivianos		
Others: Dispatch of students to Bolivia financed by JST		
Bolivian Side:		
Main Counterparts: 18 people		
Equipment: XXX bolivianos		
Facilities: two rooms in UMSA		
Local Cost: 690,000 bolivianos		
II. Evaluation Team		
Members of Eval. Team	< Japanese Side > Leader: Mr. Akihiro MIYAZAKI, Director, Water Resources Management Division 2, Global Environment Department, JICA Water Resources: Mr. Kenji NAGATA, Senior Advisor, JICA Cooperation Planning: Mr. Masanori YAMAZAKI, Water Resources Management Division 2, Global Environment Department, JICA Evaluation Analysis: Dr. Makoto TANAKA, ICONS Inc. Interpreter: Ms. Setsuko OTAKI, JICE Project Evaluation (JST): Dr. Kotaro INOUE, Principal Fellow, JST Project Evaluation (JST): Ms. Misato UNOSE, Assistant Programme Officer, JST < Bolivian Side > Evaluator: Prof. Mario TERÁN, Professor, Institute of Material Testing, UMSA (former Dean of Faculty of Engineering) Evaluator: Ms. Fany Elba SARZURI Bernal, Vice Ministry of Water Resources and Irrigation, MMAyA	
Eval. Period	26 July 2014 - 17 August 2014	Type of Evaluation: Terminal Evaluation
III. Results of Evaluation		
3-1 Confirmation of Achievement		
(1) Outputs		
<u>Output 1: likely to be achieved during the Project period</u>		
Index 1-3 “At least 2 articles of the research on models are published in international journals with peer review.” has already been achieved. Index 1-1 “User-guide for the model is prepared by C/P and the scholars involved in the Project.” and Index 1-2 “C/P who is in charge for Snow and Ice Group conducts at least one model seminar to relevant personnel of UMSA.” have almost been achieved.		
<u>Output 2: likely to be achieved during the Project period</u>		
Index 2-3 “At least 2 articles of the research on models are published in international journals with peer review.” has already been achieved. Index 2-1 “User-guide for the model is prepared by C/P and the		

scholars involved in the Project.” and Index 2-2 “C/P who is in charge for Runoff group conducts at least one model seminar to C/P of relevant personnel of UMSA.” will be achieved in August 2014.

Output 3: will be achieved just after the Project termination

Index 3-1 “User-guide for the model is prepared by C/P and the scholars involved in the Project.” and Index 3-2 “C/P who is in charge for Sedimentation group conducts at least one model seminar to relevant personnel of UMSA.” will be achieved in August 2014. Index 3-3 “At least 2 articles of the research on models are published in international journals with peer review.” will be achieved just after the Project termination.

Output 4: likely to be achieved during the Project period

Index 4-1 “User-guide for the model is prepared by C/P and the scholars involved in the Project.” has almost been achieved. Index 4-2 “C/P who is in charge for Water Quality group conducts at least one model seminar to relevant personnel of UMSA.” has already been achieved. Index 4-3 “At least 2 articles of the research on models are published in international journals with peer review.” is likely to be achieved during the Project period.

Output 5: likely to be achieved during the Project period

Index 5-1 “Future water resources are projected and evaluated with at least outputs of 3 GCMs.” will be achieved in 2014. (GCM: General Circulation Model)

Output 6: likely to be achieved during the Project period

Index 6-1 “A meeting with participants from relevant institutes who are in charge in water sector for La Paz and El Alto is conducted at least 3 times a year.”, Index 6-3 “Water quality of key parameters at least 10 alternative water sources is examined based on either WHO or Bolivian water quality standards.”, Index 6-4 “Outputs of model for the evaluation of the impact on water resources under climate change scenarios are shared in the periodical meetings for discussion on the water resources for the cities of La Paz and El Alto.” and Index 6-5 “Either C/P or the scholars involved in the Project make presentations in the open symposium.” have already been achieved. Index 6-2 “User-guide for the Water Demand model is prepared by C/P and the scholars involved in the Project.” and Index 6-6 “Public relation materials and data catalogue are prepared.” are likely to be achieved during the Project period.

(2) Project Purpose: Likely to be achieved during the Project period

Index 1 “The outputs of project is mentioned or referred in water resources management policies under climate change scenarios, other projects, or researches.” has already been achieved. Index 2 “Model for the evaluation of the impact on water resources under climate change scenarios (Support system) is installed in IHH with staff who are capable to respond to the needs (information) of water related organization.” has already been achieved in its first part “Model for the evaluation of the impact on water resources under climate change scenarios (Support system) is installed in IHH” and will be achieved during the Project period in its second part “with staff who are capable to respond to the needs (information) of water related organization”. Index 3 “The outputs of above model are uploaded in the website or stored in digital media and distributed to the concerned organization.” is likely to be achieved during the Project period.

3-2 Summary of Evaluation Results

(1) Relevance: High

Tropical glacier is one of the main water resources of the Metropolitan of La Paz and El Alto. Tropical glacier is very sensitive to climate change; actually the glacier targeted in the Project is visibly retreating and water resources from it would reduce. On the other hand, the demand for water in the Metropolitan of La Paz and El Alto continues to increase due to population inflow from other areas. It may cause serious situation if no countermeasures are taken in future. According to the Act No. 300 “Act on Framework of General Development for Mother Earth and to Live Well”, which was enforced in early 2014, the Project Purpose is thought to fit the subject on water resources development.

The Project also agree with the Japanese ODA policy for Bolivia. “Assistance Policy for Each Country: Bolivia” by the Ministry of Foreign Affairs designates “water and sanitation” as one of the development subjects.

The implementation of the Project is very significant since it would propose scientific knowledge on water supply considering the influence by climate change to draft the Bolivian water resources policies. MMayA also expects the effect of the Project. There are few examples of the development of integrated model on melting, runoff, sediment and water quality targeted to glacier basins. Japan can contribute to

settle problems on water resources by using its technology since it has academic knowledge on using snow and ice as water resources. Such knowledge is also reflected to the Project design: five research groups are installed and the roles of each group and the relationship between them are clearly defined. It can be said that the research method is appropriate.

(2) Effectiveness: High

From the achievement of the three indices of the Project Purpose, it is likely to be achieved during the Project Period. The six Outputs contribute to the achievement of the Project Purpose. Thus the Project Purpose is judged to be achieved because of the 6 Outputs.

(3) Efficiency: Moderate

The Efficiency of the Project is moderate. However, it should be admired that most parts of the Project Outputs have been achieved by the great effort of persons concerned under severe restriction described below. External factors such as disaster, natural environment and purchase of machines made the Efficiency lower.

[Efficiency of inputs from the Japanese side]

“The 2011 off the Pacific coast of Tohoku Earthquake” prevented the activities by the Japanese researchers. The purchase of the observation machines delayed due to taxation. Some of them were stolen or destroyed after installation. Under serious natural environment, it was required to make looser plans than originally expected. In rainy seasons, the activities were often prevented: the Project vehicles sometimes stacked in mud. These difficulties did not result in large delay in the consequent activities, but it is probable that the activities could have been faster unless they had not been limited.

[Efficiency of inputs from the Bolivian side]

The JICA long-term trainees was selected in Bolivia with the conditions of specialties, English skills, degrees and that they should continue their research even after they finish the course. The selection delayed since it needed a long time to find candidates that satisfies these conditions. Serious natural environment affected the activities by the Bolivian researchers as well. The Public and Social Company of Water and Sanitation (EPSAS), which has important relation with the Project, often experienced structural changes as well as personnel changes, resulting in taking a long time in sharing information with new persons in charge. EPSAS offered only limited statistical data on water quality monitoring etc. This caused insufficiency such as loss of time for research activities and duplicated measurement etc.

(4) Impact: There are expected positive Impacts

- This Project is the first challenge to the problem of water resources affected by climate change, targeting the Metropolitan of La Paz and El Alto, the world highest capital region. The Project effect is leading and is expected to spread to similar areas since high areas are strongly affected by climate change.
- The Japanese researchers were invited to the Seminars on Adaptation in Water Resources Management to Climate Change (Feb. 2013 and Jun. 2014) and had keynote lectures there on methods for evaluating the influence by climate change using basin management models intending for practical engineers.
- Sedimentation model in basins, one of the Project results, is referred in “Adaptation to the Impact of accelerated glacier retreat in the Tropical Andes” (PRAA), a project in “National Climate Change Program” (PNCC) financed by the World Bank (WB). It is also expected that some of the Project results will be referred in PRAA2, a succeeding project of PRAA.
- It is a rare case in Bolivia that an academic entity such as UMSA and an administrative organization such as MMAyA act on common subjects. The Project enhanced their mutual exchange and communication. This relationship is likely to develop into the one with mutual merit: MMAyA can tackle the problem of water resources with the aid of UMSA and UMSA can obtain new research subjects on water resources from MMAyA.
- There are seen no negative impacts.

(5) Sustainability: High or moderate depending on solving subjects

The Sustainability of the Project mainly depends on the following three subjects. Currently the Sustainability is moderate since the three subjects have not solved yet, however, it is likely to be high if

these are solved.

1. Organizational aspects: EPSAS, which would apply the Project results, would offer data to make the model as the Project results durable, and participate in the Water Resources Platform.
2. Organizational aspects: Field would be prepared for the returning JICA long-term trainees to continue their research.
3. Technical aspects: The Bolivian side would understand the engineering issues such as the application limit of the models developed in the Project and the points to be corrected for reflecting local conditions in applying them to other basins.

There are seen no problems in policy and institutional aspects, financial aspects, technical aspects and society, culture and environmental aspects.

3-3 Factors Promoting Sustainability and Impact

(1) Factors Concerning Planning

The eight JICA long-term trainees have played great roles in the communication between the Japanese and Bolivian sides since they know much about the research and they are good English speakers.

(2) Factors Concerning the Implementation Process

The implementation of the Project made the relationship between UMSA, the C/P entity and MMAyA, a ministry very tight to enhance their communication.

3-4 Factors Inhibiting Sustainability and Impact

(1) Factors Concerning Planning

Some researchers suffered from mountain sickness and were forced to limit their activities. Some of the Japanese researchers had difficulties such that their vehicle stacked in mud in rainy seasons and that they were forced to stay rest quietly in bed due to extreme fatigue in access to the glaciers. It was effective for such difficulties that the plan of site activities is made leeway first and then tighter. These difficulties did not result in large delay in the consequent activities, but it is probable that the activities could have been faster unless they had not been limited.

(2) Factors Concerning the Implementation Process

Most of the eleven Japanese researchers were made impossible to enter the buildings of their affiliation or forced to move several times due to the 2011 off the Pacific coast of Tohoku Earthquake. Blank occurred in the contract between their affiliation and JICA in the first half of FY 2011 to cause delay in their activities. This factor was overcome because of their effort afterward.

The purchase of the observation machines delayed due to taxation. Some of them were stolen or destroyed after installation.

Some of the Japanese researchers could not reach the concerned sites due to blocked roads when they visited Bolivia.

3-5 Conclusion

- The Project is achieving the Outputs 1 to 6 after flexibly conducting the review and correction of the PO. Therefore the Project Purpose is likely to be achieved during the Project period.
- The results of the examination on the five evaluation criteria are as follows. The Relevance of the Project is high. The Effectiveness is high since the six Outputs are being achieved and contribute to the achievement of the Project Purpose. The Efficiency is moderate according to moderate efficient inputs by both the Japanese and Bolivian sides. The Project is expected to produce positive Impacts. The Sustainability of the Project mainly depends on three subjects. Currently the Sustainability is moderate since the three subjects have not solved yet, however, it is likely to be high if these are solved.
- From above, it is desired that the three subjects are solved for making the Sustainability higher as described in “3-2 (5) Sustainability”.

3-6 Recommendations

- To examine the application limit of the models developed in the Project local conditions in applying them to other basins.
- To apply the Project results, to understand the necessity of comprehensive water resources plans including groundwater and water resources in other basins and to discuss them in the Water Resources Platform.

3-7 Lessons Learned

- This Project is a SATREPS project: most of its activities are research. The Project could implement fruitful activities by flexibly reviewing and correcting the PO if needed. Describing concrete items by reviewing the indices of the Project Purpose and the Outputs during its implementation contributed to clarify the Effectiveness of the Project.
- The cities of La Paz and El Alto, the target area of the Project, are 3,000 to 4,000 meters in elevation. The targeted glaciers are located in areas of higher elevation of 4,500 to 4,900 meters. The access roads to the glaciers become muddy in rainy seasons. Some of the observation points cannot be accessed by vehicles and require wading access. If the persons concerned fail to adapt to such serious natural environment to suffer or to be injured, it will affect to the progress of the Project afterward. To avoid such situation, it was effective for such difficulties that the plan of site activities is made leeway first and then tighter.
- In this Project, there were no Japanese researchers who understand Spanish and few Bolivian researchers who understand English. Persons are necessary who can overcome the difference in languages and know much about the research contents, for Japanese researchers to collaborate with researchers in Spanish-speaking countries like Bolivia, since the difference in languages may prevent smooth communication. In this Project, the selected eight JICA long-term trainees greatly contributed to the improvement of communication between the researchers since English language was one of the required conditions of their selection.
- To promote social implementation in similar projects in future it is important to involve engineers who would apply research results as researchers in a wide sense from early periods.
- At the initial stage of the Project, the details of SATREPS regulation was not commonly recognized among JICA, JST and the concerning universities. This prevented smooth implementation of the Project. It is necessary to ferment common understanding among concerning entities in future project formation.

3-8 Follow-up

None.